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Development of 1.3-GHz range imaging wind profiler radar

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Radar wind profiler (WPR) is a useful means to measure altitude profiles of vertical and horizontal wind velocities in the clear air. Because WPR receives echoes from Bragg-scale refractive index perturbations caused by turbulence, WPR is able to be used for measuring atmospheric turbulence. However, vertical resolution of WPR (typically 100 m or more) is not sufficient for measuring atmospheric turbulence quantitatively. Range imaging (RIM), which is useful for resolving fine-scale structure of atmospheric turbulence such as Kelvin-Helmholtz billows, has developed recently. RIM improves range resolution down to several ten meters by using frequency diversity and adaptive signal processing. At Shigaraki MU Observatory Japan, we are developing a 1.3-GHz range imaging WPR (RIM-WPR) in order to realize turbulence measurement in the lower troposphere. Antenna, transmitter, and receiver of the existing WPR (named as LQ7) are used for RIM-WPR. To transmit multiple frequencies, five local oscillators (1357.0-1358.0 MHz with 250 kHz intervals) are installed. Further, for collecting received time series every transmitted frequency, we newly developed a radar software receiver using Universal Software Radio Peripheral 2 (USRP2). In addition to the functions necessary for performing the multi-frequency data collection, the new radar software receiver is able to execute oversampling with a maximum sampling rate of 10 MHz. Combining RIM and oversampling provides a sufficient capability to detect small-scale turbulence with a scale 100 m or less.

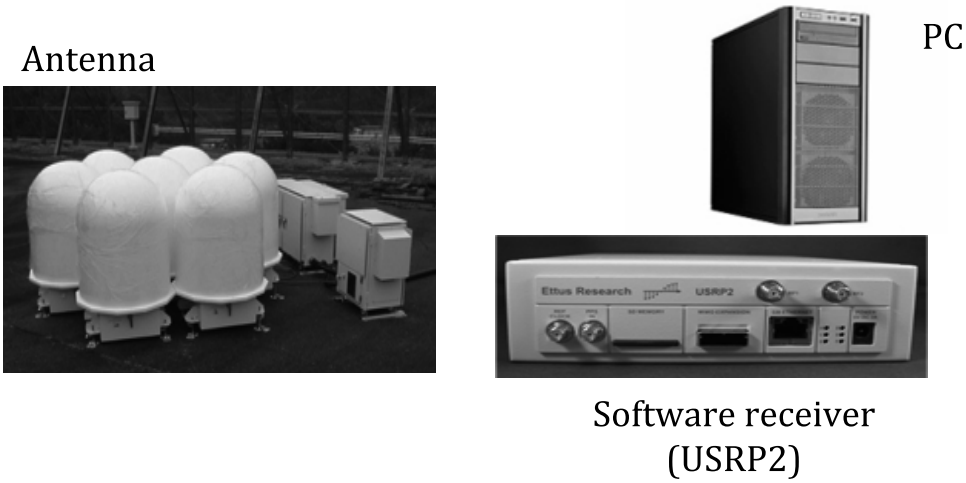

Figure 1. Components of the 1.3-GHz range imaging wind profiler radar.

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